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ABSTRACT

Although the student materials in associated documents are intended to be self-instructional, this manual contains material aimed at instructors who may be teaching that course for television repair technicians. The manual consists of a list of training topics that constitute the seven-part course, the profile and qualifications recommended for instructors, a list of entry requirements for students, suggested training equipment and workshop layout, a suggested evaluation method and 13 sample quizzes (consisting of circuit diagrams and multiple-choice questions about them) to evaluate student performance, and a training syllabus to which the instructor can add the number of training hours to be devoted to each topic and then duplicate to distribute to students. (CML)

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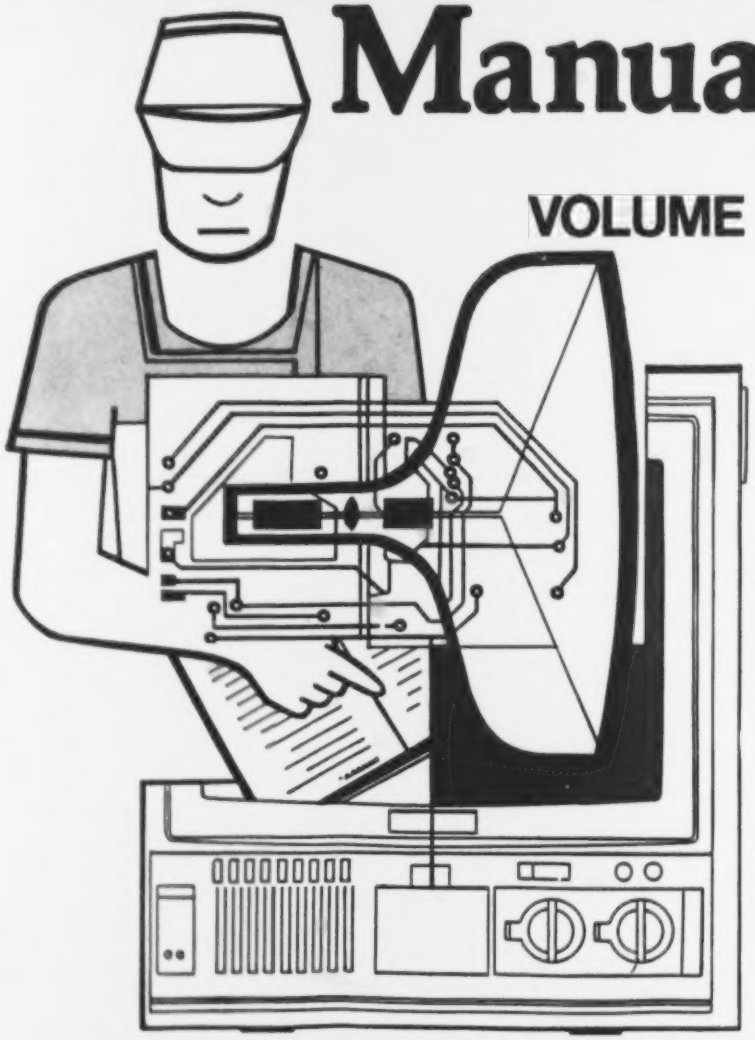
TV Trouble-shooting Manual

VOLUME



BY MASAAKI MUKAI AND RYOZO KOBAYASHI

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VOLUME 2

BY MASAAKI MUKAI AND RYOZO KOBAYASHI

ASIAN AND PACIFIC SKILL DEVELOPMENT PROGRAMME
INTERNATIONAL LABOUR OFFICE
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Power-supply circuit

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Voltage-regulator circuit

1 Transistor voltage-regulator circuit
2 SCR voltage-regulator circuit

Instructor's profile and qualifications

Although these TV repair manuals, theory and trouble-shooting are designed for instructor-free self-training, the training will be more effective if it is supervised by any one of the following qualified technical personnel:

1 Holder of a vocational instructor's certificate or its equivalent in consumer electronic products with at least two years' working experience in the repair of TV receivers.

2 Holder of a teacher's certificate or its equivalent in industrial education covering electricity and electronics with at least two years' teaching experience.

3 Holder of a first-class trade-skill certificate in radio and TV repair honoured by APSDEP with at least five years' on-the-job experience in radio-TV repair.

4 An authorised instructor in TV repair at a national training and trade certification agency in vocational training.

5 One who is authorised by APSDEP as an instructor in TV repair.

Instructors intending to use this TV repair training package are advised to undergo intensive technical briefing on the effective use of this training manual.

Entry requirement

One who uses this TV repair package for training should have some trouble-shooting and repair experience in consumer electronic products such as AM-FM transistor radios.

Basic knowledge of the following is helpful in understanding the contents of the training package:

1 Workshop mathematics and science: addition, subtraction, multiplication and division; static electricity, etc.

2 Basic electric circuit and current: alternating current (AC) and direct current (DC); Ohm's law.

3 Resistor: types of resistors; series and parallel connections.

4 Inductor: types of inductance, transformers; series and parallel connections.

5 Capacitor: types of capacitance; series and parallel connections.

6 Simple AC and resonance circuits.

7 Measuring simple voltage, current and resistance with a multi-meter (VOM).

8 Diodes and transistors.

9 Simple diode and transistor circuit.

10 Function and symbols of major electronic components.

11 Basic electronic measuring instruments used in radio and TV repair such as multi-meter, electronic meter, transistor checker, signal generator, oscilloscope, etc.

12 Schematic diagram reading such as pictorial circuit diagram.

13 Hand tools used for repair in electronics.

14 Safety in working with electricity: work safety, hazard prevention in work, first aid.

Suggested training equipment and workshop layout

The major training equipment suggested to be used in this TV trouble-shooting package consists of the following:

List of first-priority equipment

Item No.	*Description/ specification*	*Quantity for 15 trainees*	*Unit price in US$*
1	Multi-meter, VOM DC voltage 0.1/0.5/2.5/10/50/250/1kV (20k ohm/V) AC voltage 10/50/250/1kV (8k ohm/V) DC current 50u/2.5mA/25mA/250mA Resistance 20/200/2k/20k/2M ohm	15	
2	Audio-signal generator 5Hz-500kHz, Sine and square waves	3	
3	R.F. signal generator 100kHz–250MHz, Internal AM modulation	3	
4	Colour TV signal generator Colour bars Dots and cross-hatch pattern	3	
5	Electronic-volt meter 300uV-100V, 10Hz-1MHz	3	
6	High-voltage meter Up to 30 kV, Input resistance 600Mohm	3	
7	Transistor checker Transistor, J-FET, MOS-FET, SCR, etc.	3	
8	Cathode-ray-tube checker	1	
9	TV signal field strength meter TV: Och-83ch (VHF/UHF) VHF: 20-120dB UHF: 30-100dB	1	
10	Triggered oscilloscope Sensitivity: 5mV-5V/div Frequency: DC-20 MHz	3	

Item No.	*Description/ specification*	*Quantity for 15 trainees*	*Unit price in US$*
	Single trace		
11	LCR meter (universal bridge) L: 0.1uH-9999H C: 0.1pF-9999uF R: 0.01 to 9.999 M Ohm	3	
12	DC power supply 1 0-30V, 3A	6	
13	DC power supply 2 0-250V, 0.2A	3	
14	B/W television set	3	
15	Colour TV set Shadow mask, 14in	3	
16	Colour TV set Trinitron, 14in	3	
17	Signal injector/tracer	6	
18	Degaussing tool	3	
19	Assorted TV antennas with cable	1	
20	Tool set: assorted screwdrivers; assorted socket screwdrivers; assorted wrench; assorted socket wrench; soldering iron, small, 30 watts; soldering iron, medium, 60 watts; de-soldering tool; pliers; electrician's pliers; long-nose pliers; side diagonal cutter; files, flat and round; wire brush; cutters; tweezers; assorted alignment tools; small flashlight; hair dryer (for heating components)	15	

List of second-priority equipment

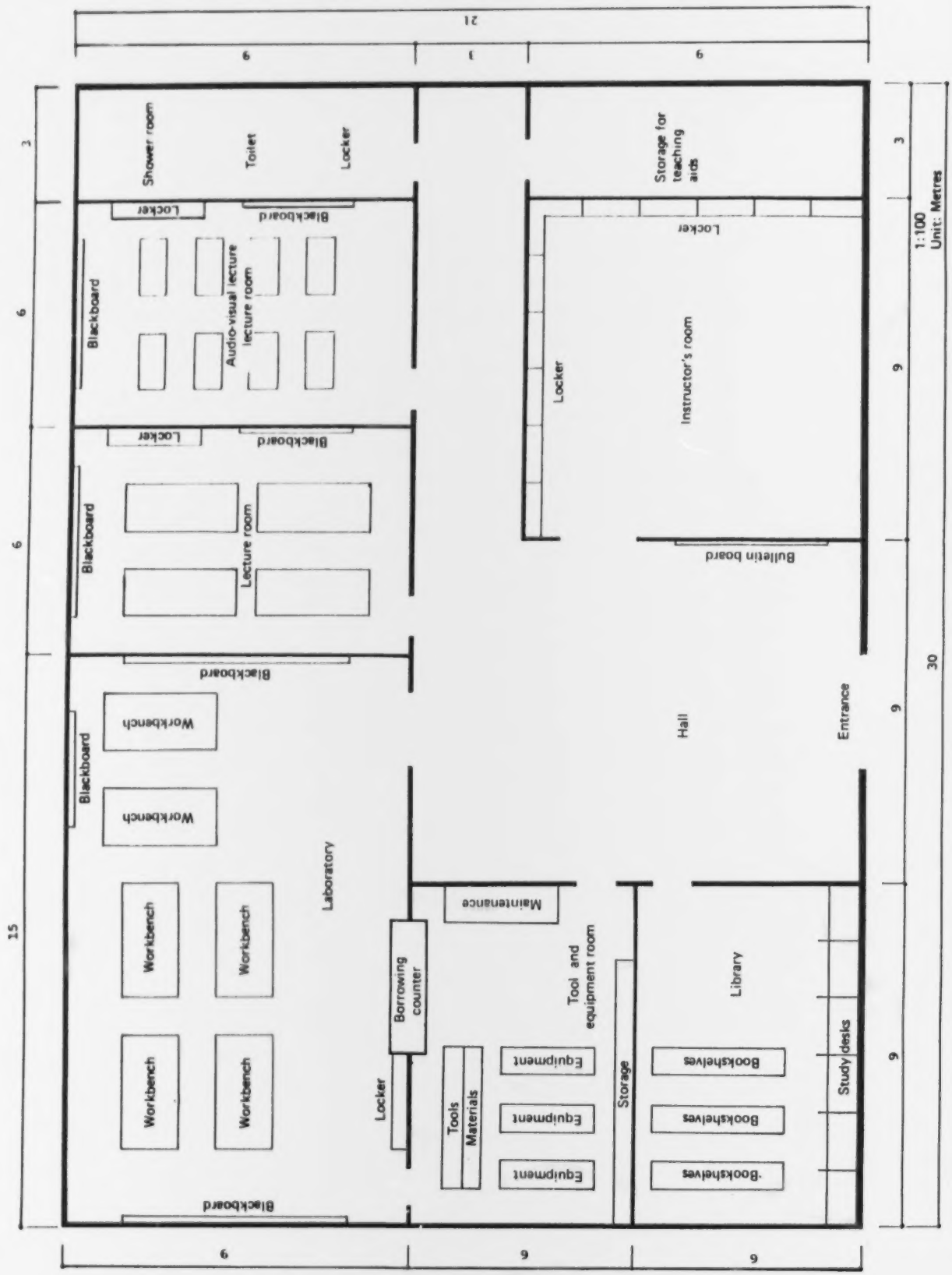
Item No.	*Description/ specification*	*Quantity for 15 trainees*	*Unit price in US$*
1	Triggered oscilloscope Sensitivity: 5mV-5V/div Frequency: DC-20MHz Dual trace with delay line	2	
2	TV sweep generator VHF, 2-300MHz Sweep width 20MHz	1	
3	Marker generator Frequency: 2-300MHz	1	
4	TV ghost-signal checker Input: 75ohm unbalanced VHF: 25-125dB UHF: 35-105dB With small CRT	1	
5	AC milli-volt meter 300uV-100V	3	
6	AC volt, ammeter 45-65Hz, 0.15-30A, 30-750 ACV	3	
7	DC volt, ammeter 1-300mA, 3-1000 DCV	3	

Suggested training materials and supplies

The major training materials and supplies suggested to be used in this TV trouble-shooting package are the following:

List of training materials and supplies

Item No.	*Description/ specification*	*Quantity for 15 trainees*	*Unit price in US$*
1	Assorted transistors: PNP, NPN transistors, FET, J-FET, UJT, SCR, SCS, etc.		
2	Assorted diodes: germanium, silicon, zener diode, etc.		
3	Assorted resistors: carbon-film resistors, 1/4W; carbon-film resistors, 1/2W; composition-fixed resistors, 1/2W; metal-oxide film resistors, 1W; metal-oxide film resistors, 2W; wire-wound resistors, 1/2W; flame-proof cement-insulated wire-wound resistors, 3-10W.		
4	Assorted capacitors: polyester-film capacitors, 100V; electrolytic capacitors, 160-350V; electrolytic capacitors, 10-470uF, 16,25,50V; polypropylene film capacitors, 250-1kV; ceramic capacitors, 1pF-0.01uF, 50V; stirol-film capacitors, 100pF-4, 7kpF, 500V; oil-impregnated capacitors, 500WV.		
5	Assorted integrated circuit commonly used in TV receivers		
6	Assorted variable resistors commonly used in TV receivers		
7	Assorted fuses commonly used in TV receivers: 0.1-6A glass tube fuses, temperature fuses, 120-150 degrees/C		
8	Assorted solderless terminals		
9	Assorted terminals		
10	Assorted electronic components: switches, plugs and jacks; alligator clips; banana plug; coils; transformers; speakers; dry-cell batteries, etc.		
11	Assorted wires: solid, stranded, shielded, coaxial, lead-plated, etc.		
12	Assorted substances used for electrical maintenance: contact cleaners, silicon compound, voltage leak-proof solution, Freon gas, etc.		
13	Assorted consumables: screws, nuts, soldering lead, de-soldering wick, etc.		


21
6
3
6
Shower room
Toilet
Locker
Storage for teaching aids
Locker
Blackboard
Blackboard
Audio-visual lecture
lecture room
Locker
Instructor's room
Locker
Blackboard
Blackboard
Lecture room
Bulletin board
Blackboard
Workbench
Blackboard
Workbench
Hall
Entrance
Workbench
Workbench
Laboratory
Maintenance
Borrowing counter
Tool and equipment room
Library
Workbench
Workbench
Equipment
Bookshelves
Locker
Tools
Materials
Equipment
Storage
Bookshelves
Equipment
Bookshelves
Study desks
Blackboard
15
3
6
9
9
30
1:100
Unit: Metres
6
9
9

Evaluation method and sample evaluation materials

For evaluating knowledge and skill of TV repair technicians, one should use associated TV trouble-shooting manuals as evaluation materials.

In this manual, 45 typical TV troubles and their trouble-shooting procedures are discussed in detail.

The best way of evaluating skill and knowledge is to simulate trouble symptoms by a test TV receiver set and discuss the symptom, possible cause and damaged stage in detail. Technical discussion is more important than aimless practical trouble-shooting.

During the lecture, the respective functions of various stages and components should be well explained to the trainees. Simulating a trouble by a defective component and conducting a technical discussion on the functions of that particular component are also important to improve the knowledge and skill of the TV repair technician.

Intensive technical discussion on the function of front and service controls is also important. Technicians should know how to isolate defective stages and components by simply adjusting these controls.

Besides evaluating knowledge and skill by the *TV Trouble-shooting Manual*, the following samples of technical quizzes are ideal for technical evaluation of TV repair technicians. The technical quizzes in vertical deflection circuits are shown as examples.

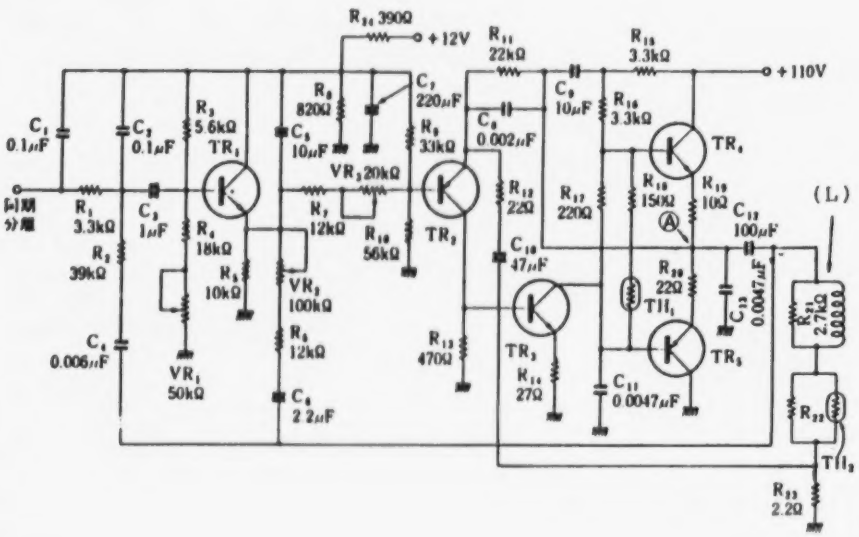
SAMPLE QUIZ 1

Select the correct answer.

1 The circuit diagram shown in the figure is used for a) vertical deflection b) horizontal deflection c) audio amplifier circuit. This circuit is a a) blocking oscillator, b) multivibrator and c) crystal oscillator circuit.

2 Output transistors TR4 and TR5 consist of a) parallel push-pull, b) single ended push-pull, c) class A amplifier circuit.

3 The inductor (L) pointed by an arrow is a) vertical output transformer, b) flyback transformer, c) vertical deflection coil.



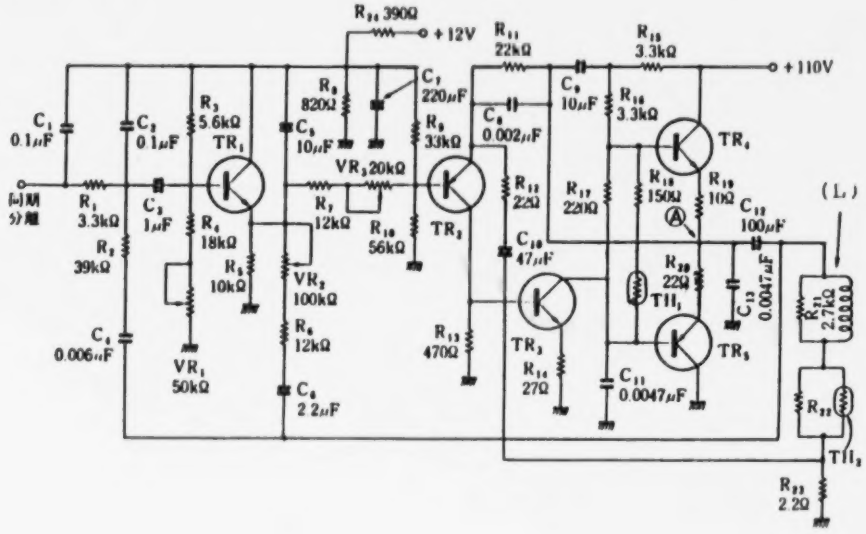
SAMPLE QUIZ 2

Select the correct answer.

1 When power is supplied to the circuit shown, emitter voltage of transistor TR1 is driven to (a, positive b, negative c, constant) by the charging current of capacitor C5 through (a, R5 b, VR_2 c, R7).

2 When charging of capacitor C5 continues, charging current (a, increases b, is kept constant c, decreases) and transistor TR1 (a, is cut off b, starts to conduct c, is saturated). At the same time it will discharge capacitor C5.

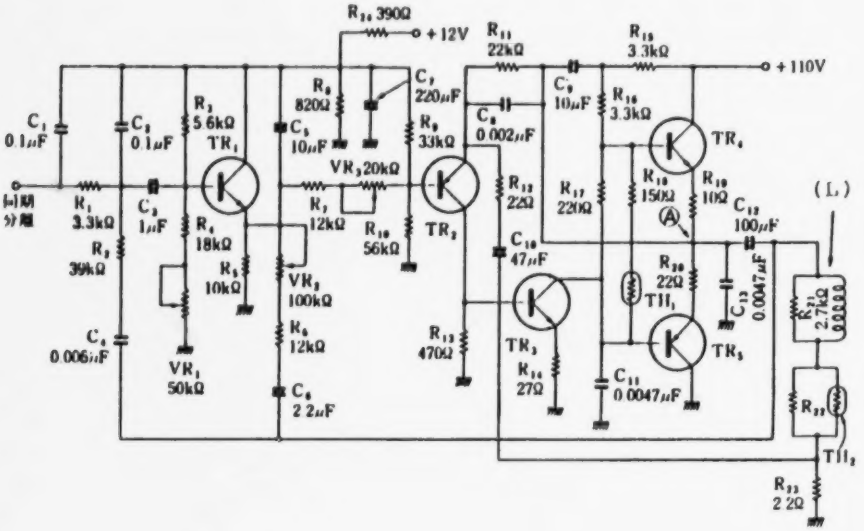
3 The emitter voltage of transistor TR1 (a, rapidly b, moderately c, slowly) increases when transistor TR1 conducts. This is because the change in emitter voltage of transistor TR1 is amplified by transistors TR2, TR3, TR4&5 and then fed back to the base of TR1. Thus, TR1 is instantly (a, cut off b, saturated c, triggered).



4 On the other hand, the current, which is proportional to the change in output voltage, flows in the deflection coil. With (a, rapid b, moderate c, slow) change of the output voltage, (a, sawtooth b, pulse c, parabolic) voltage is generated in the deflection coil. This voltage is fed back to the base of TR1 through C4 and R2. A capacitor C3 in the base circuit of transistor TR1 is charged with the base current.

5 Without a feedback signal from the deflection circuit, TR1 is (a, cut off b, saturated c, triggered) by the charged voltage of capacitor C3, and the charging of capacitor C5 starts again.

6 With repeated action of the procedures described from #1 to #5, (a, sawtooth b, pulse, c, parabolic) voltage is produced across the emitter resistor R5.

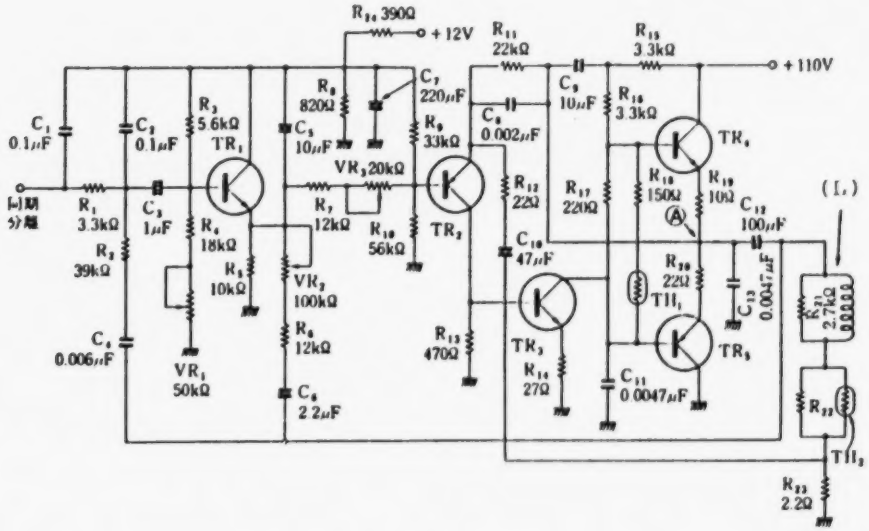


SAMPLE QUIZ 3

Select the correct answer.

1 The circuit diagram shown is used in a (a, horizontal-deflection, b, vertical-deflection c, audio-amplifier) circuit and it is a (a, blocking b, multivibrator c, crystal-oscillator) circuit. The output circuit is a (a, parallel b, double-ended c, single-ended) push-pull circuit.

2 The transistor TR1 conducts when (a, positive going b, negative going c, flyback) pulses are supplied to the base. The (a, sawtooth b, pulse c, parabolic) voltage is produced at the emitter circuit.



SAMPLE QUIZ 4

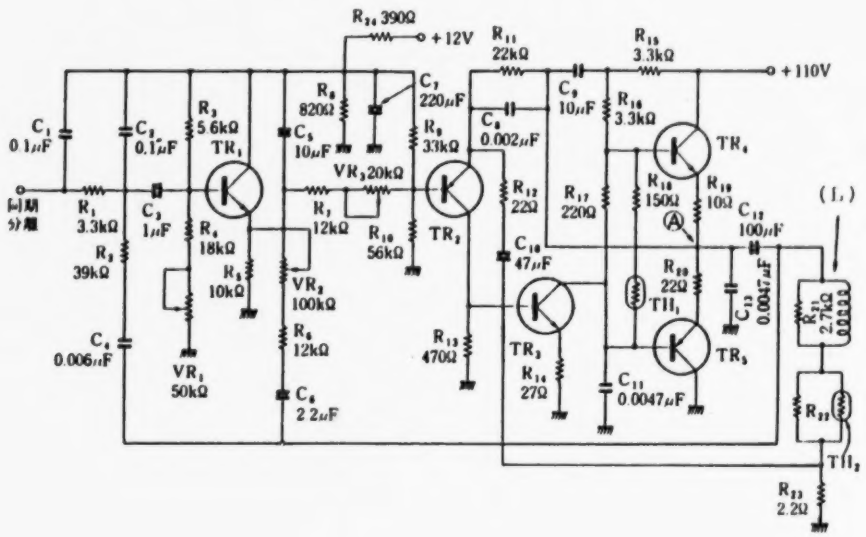
Select the correct answer.

1 In the collector circuit of TR2, (a, the same b, out of c, reversed) phase signal which compares with the signal at the emitter of transistor TR1 can be observed.

2 Transistor TR3 works as a (a, class A b, class B c, Class C) amplifier and it supplies signals to the base of output transistors TR4 and TR5.

3 The output transistor TR4 conducts when base voltage (a, increases b, decreases c, is kept constant) and it will conduct at the (a, first half b, second half c, whole) cycle of vertical deflection.

4 The output transistor TR5 conducts when base voltage (a, increases b, decreases c, is kept constant) and it will conduct at the (a, first half b, second half c, whole) cycle of vertical deflection.

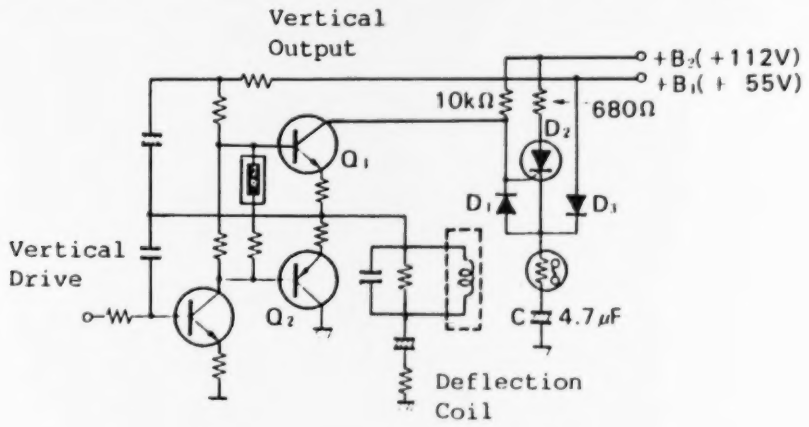


SAMPLE QUIZ 5

Select the correct answer.

1 The circuit diagram shown is an example of a simplified vertical output circuit in a TV receiver set. The component D2 is (a, UJT b, SCS c, LED).

2 During the later half of a vertical trace, transistor Q1 is cut off and the gate voltage of D2 (a, increases b, decreases c, is kept constant) and conducts. When D2 conducts, the capacitor C is charged by the (a, +B1 voltage (55V) b, +B2 voltage (112V) c, combination of B1 + B2 voltage) until the next retrace period. This voltage is also supplied to the collector of transistor Q1 through D1. When capacitor C is fully charged, D2 is automatically cut off because the voltage across (a, gate and cathode b, gate and anode c, anode and cathode) becomes zero.

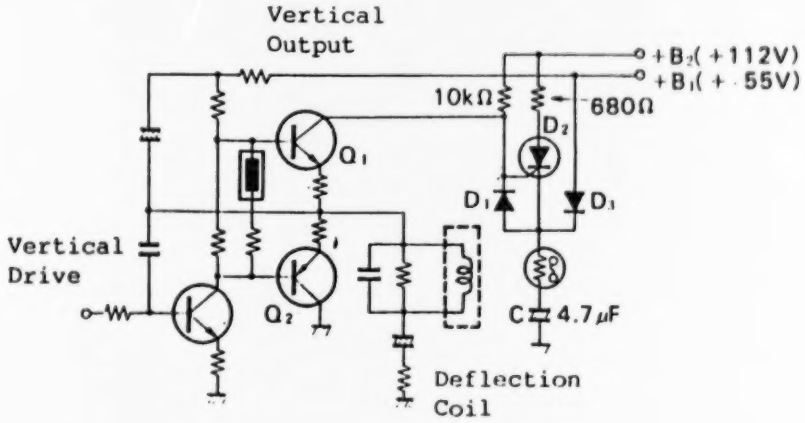


SAMPLE QUIZ 6

Select the correct answer.

1 During the first half of the vertical trace, capacitor C discharges through transistor Q1. At the same time, collector of Q1 is supplied with the voltage from (a, +B1 voltage (55 V) b, +B2 volt (112 V) c, combination of B1 + B2 voltage) through D1.

2 When the charged voltage at capacitor C is discharged, the cathode voltage of D2 decreases. Thus, the D2 (a, is cut off b, emits light c, conducts) and +B2 voltage (112 V) is supplied to the collector of transistor Q1.



SAMPLE QUIZ 7

Select the correct answer.

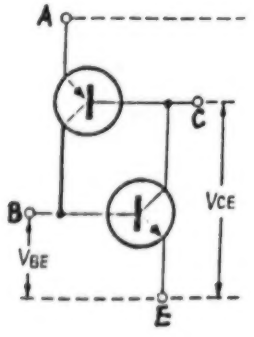
1 The SCR (silicon controlled rectifier) is a group of (a, diodes b, transistors c, thyristors). It conducts when voltage is supplied to the (a, cathode b, anode c, gate). Once the SCR conducts, it will remain ON even if the triggering voltage is removed. To cut off the SCR, the voltage across the (a, gate and anode b, anode and cathode c, gate and cathode) must be set to zero.

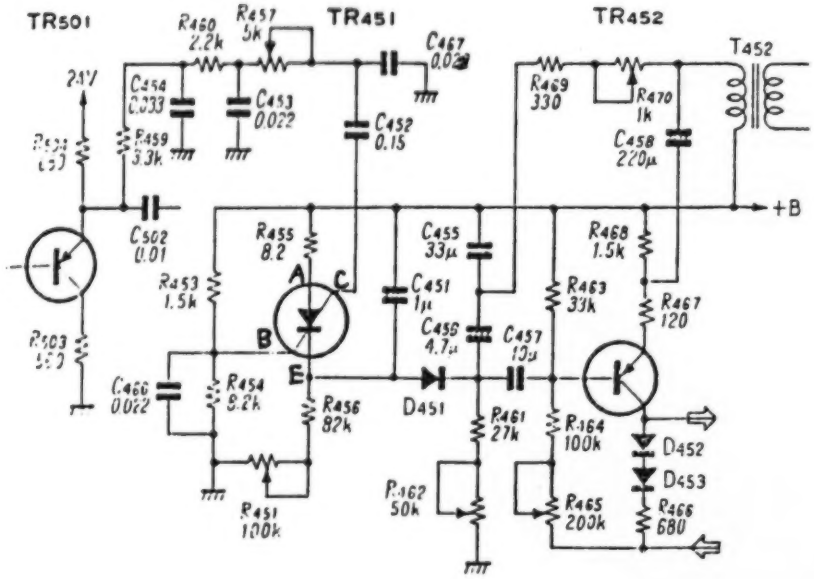
SAMPLE QUIZ 8

Select the correct answer.

1 The circuit diagram shown in Figure (a) is an example of a vertical oscillator circuit. This circuit uses (a, MOSFET b, UJT c, SCS) as a vertical oscillator. This semiconductor is a group of (a, diodes b, transistors c, thyristors). The simplified equivalent circuit using transistors is shown in Figures (b) and (c).

2 R451 adjusts the vertical (a, height b, hold c, linearity) and R465 adjusts the vertical (a, height b, hold c, linearity).





SAMPLE QUIZ 9

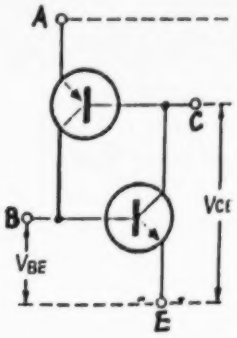
Select the correct answer.

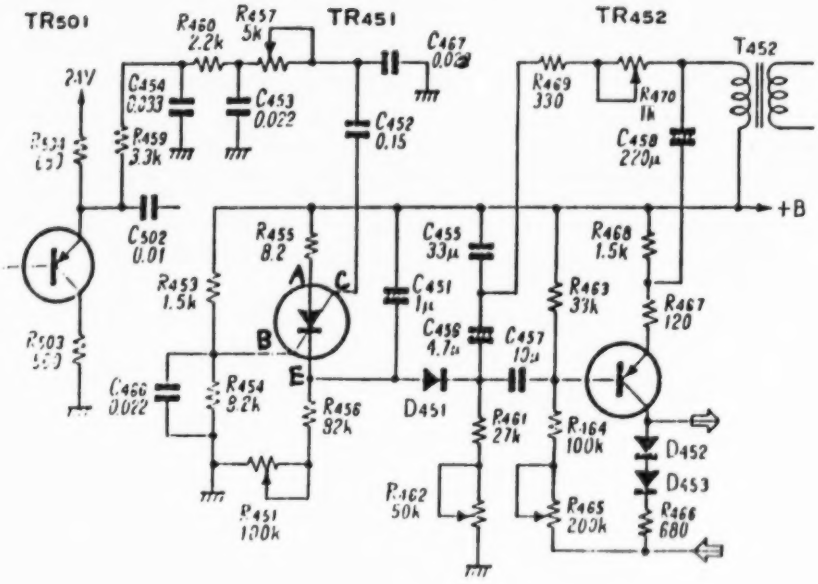
1 The sawtooth signal which is supplied to the base of transistor TR452 is produced by the charging and discharging of capacitor (a, C 451 b, C 455 and C 456 c, C 457).

The vertical sync signal is supplied to the collector of TR451 by coupling capacitor C452.

2 The network circuit comprising C454, R460, C453, R457 and C467 is a low-pass filter which is usually called (a, differentiator b, integrator c, Piezonator).

3 When TR451 is shorted, the image on the screen becomes (a, a thin vertical line in the centre b, a thin horizontal line in the centre c, vertically stretched).





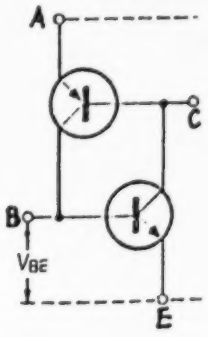
SAMPLE QUIZ 10

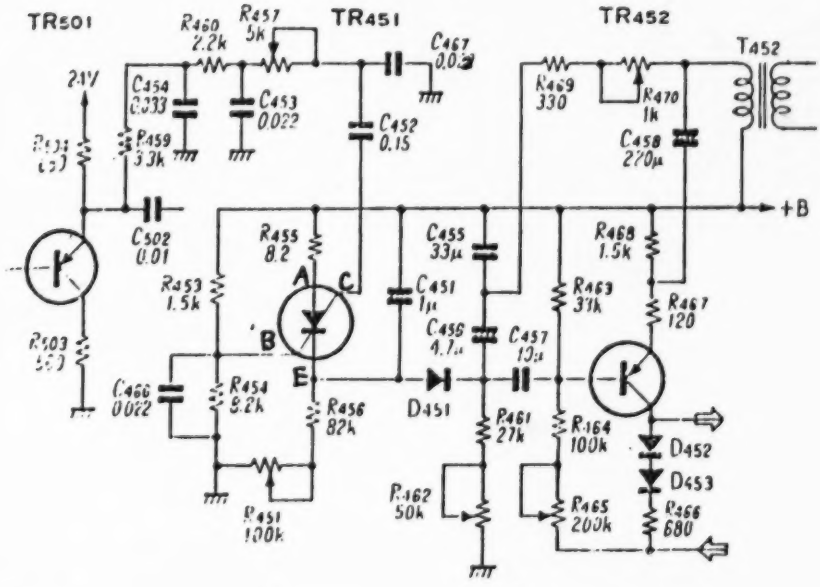
Select the correct answer.

1 A circuit diagram shown in Figure (a) is an example of a vertical oscillator circuit in a TV receiver set. This circuit uses (a, SCS b, UJT c, TRIAC) as a vertical oscillator. This semiconductor is a group of (a, transistors b, diodes c, thyristors) and equivalent circuit can be described by the use of a PNP and an NPN transistor as shown in Figure (b). The circuit functions as follows.

2 When TR451 is (a, on b, off c, on and off), capacitor C451 is charged with the current, which flows through R456, R451 and D451, R461, R462. Capacitor C451 is called a sawtooth-generation capacitor. Because of a high initial charging current, the voltage across R456, R451 increases to a level almost equal to the +B power-supply voltage. This voltage equals the emitter voltage and it is (a, lower than b, higher than c, similar to) the base voltage of TR451.

Therefore, an NPN transistor in Figure (b) gets (a, forward bias b, negative bias c, sync signals) and it is in (a, on b, off c, switching) state.





12

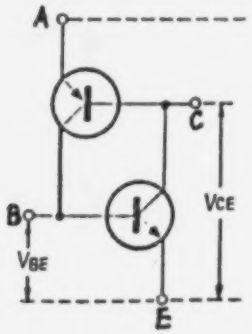
SAMPLE QUIZ 11

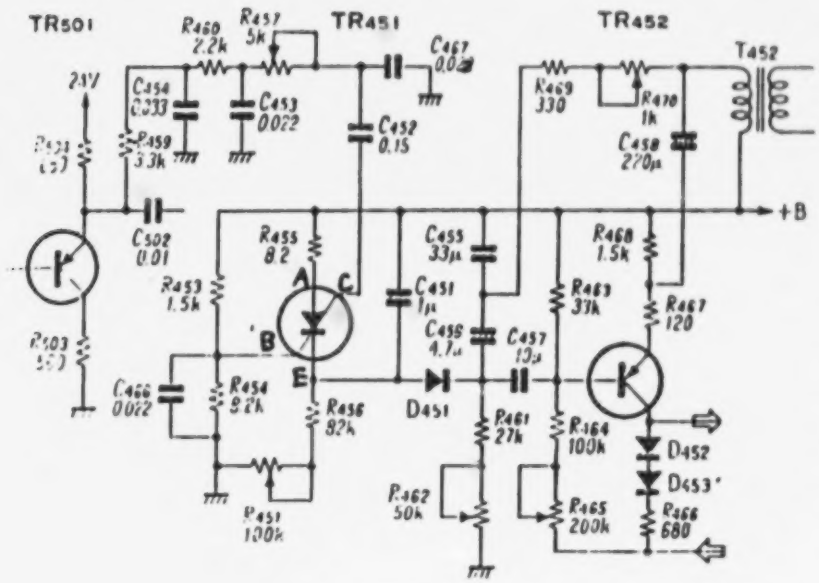
Select the correct answer.

1 The emitter voltage decreases when the constant made of C451 and the combination of R456+R451, D451+R461+R462. When the emitter voltage is lower than that of the (a, collector b, anode c, base) voltage, the base current of TR451 starts to flow. With a flow of the base current in Figure (b), the collector current of NPN transistor, which is equal to the base current of PNP transistor, increases. When the collector current of NPN transistor increases, the anode current, which is equal to the emitter current of PNP transistor, starts to flow. This current reinforces the base current of NPN transistor and increases the anode current.

2 Thus, by the positive feedback of the NPN-PNP-NPN loop circuit, the anode current of TR451 increases and the (a, base and anode b, collector and emitter c, anode and emitter) become as if it is shorted.

Capacitor C451 is connected to TR451 in parallel and it will discharge the voltage when TR451 is shorted.



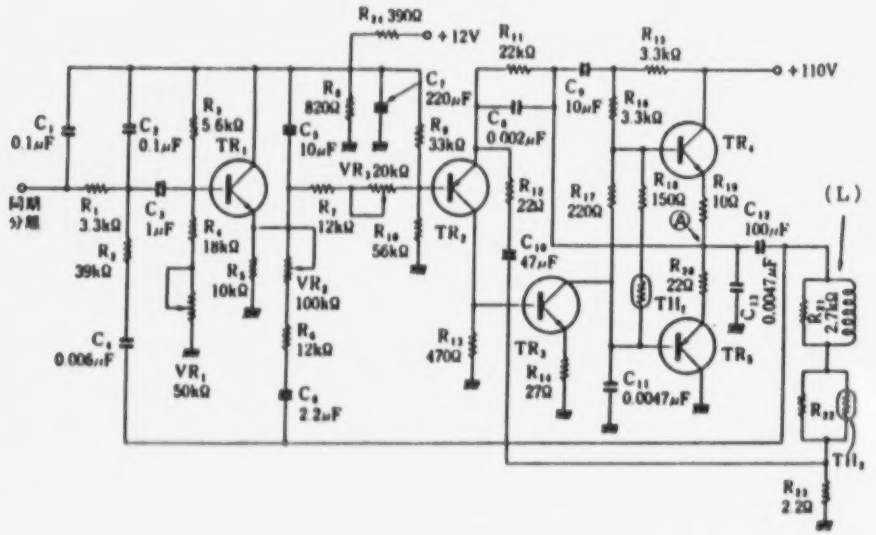


SAMPLE QUIZ 12

Select the correct answer.

1 The circuit diagram shown is an example of a vertical-oscillator circuit in a TV receiver set. It uses a (a, blocking b, multivibrator c, crystal) oscillator circuit. The circuit is a (a, positive b, negative c, neutral) feedback circuit and a part of the output signal is fed back to the input circuit. The main feedback component in this diagram is (a, R12 and C10 b, R6 and C6 c, R2 and C4).

2 When this feedback line is opened, the vertical-deflection circuit becomes an ordinary CR coupled (a, audio-amplifier b, video-amplifier c, oscillator) circuit.

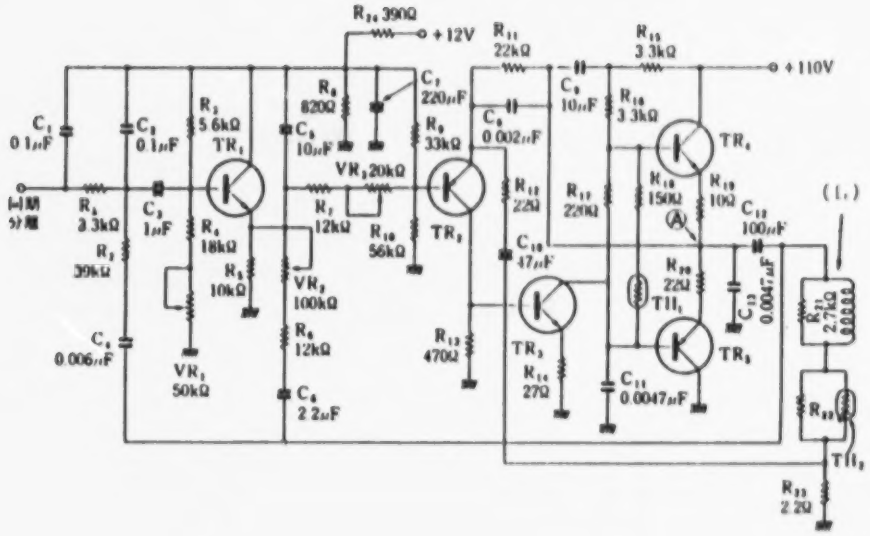


3 The symptom created by this open circuit is a (a, vertical b, horizontal c, diagonal) thin line in the centre of the screen.

However, with open feedback line, the circuit functions as an audio-amplifier circuit. Thus, the thin line expands a little when the set is tuned in to the TV station.

4 The thin line expands because the (a, video b, audio c, sync) signal in the composite video signal is amplified by the vertical-deflection circuit. The deflection coil in the circuit functions like (a, a speaker b, a CRT c, a microphone) in an audio-amplifier circuit.

5 When one of the transistors in the circuit goes out of order, the symptoms on the screen are almost the same as the symptom described above. In this case, however, a thin line does not expand when the set is tuned to a TV station.

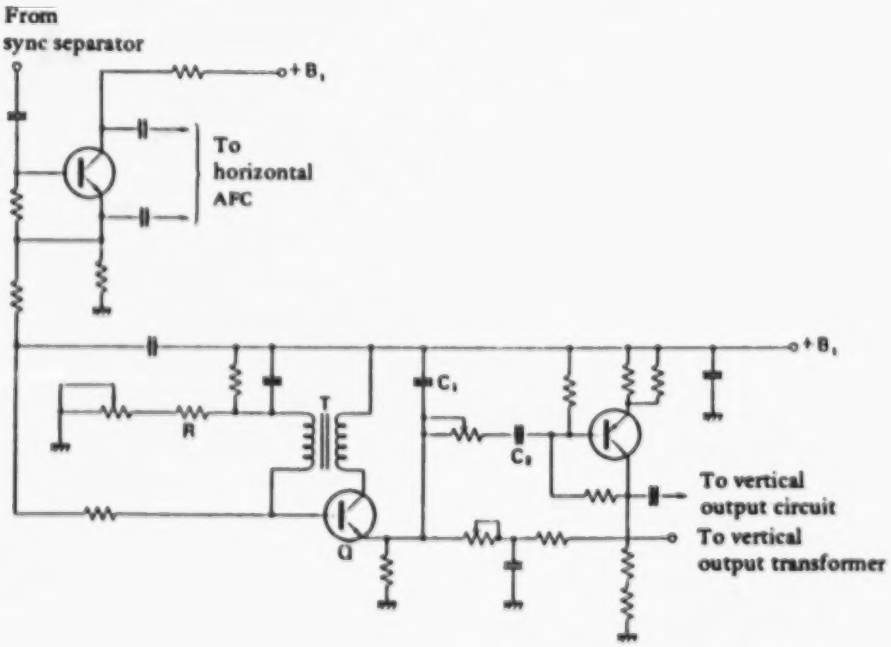


SAMPLE QUIZ 13

Select the correct answer.

1 In a TV receiver set that uses the vertical-oscillator circuit shown in the figure, the image of the picture starts to roll continuously downwards. The rolling of the image cannot be stopped by adjusting the vertical hold control.

Which of the following defects will cause the symptom? (a, shorted base and emitter of transistor TR1 b, open resistor R c, open blocking transformer T d, shorted capacitor C1 e, shorted capacitor C_2.



Training syllabus

Part 1: **Block diagram of colour TV receiver and signal flow**

Learning elements	*Training hours*
1 **Functional block diagram of a colour TV receiver**	
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Chrominance or chroma-signal reproduction circuit	
Synchronisation and deflection circuit	
Sound-reproduction circuit	
2 **Colour TV circuits and signal processing**	
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VIF-amplifier circuit	
Video-detector circuit	
Video-amplifier circuit	
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2 Deflection circuit	
Vertical deflection circuit	
Horizontal deflection circuit	
Colour-reproduction circuit	
1 Colour-demodulator section	
Bandpass-amplifier circuit	
Chroma demodulator and amplifier circuit	
2 Colour-synchronisation section	
Burst-amplifier circuit	
Colour subcarrier-generator circuit	
Sound-reproduction circuit	

Part 2: **Video signal receiving circuit**

Learning elements	*Training hours*
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Learning elements	*Training hours*
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Keyed AGC circuit	
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Contrast control	
Brightness control	
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***Part 3:* Synchronisation and deflection circuits**

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Learning elements	*Training hours*
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(when chroma and subcarrier signals are supplied togehter)	
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Learning elements	*Training hours*
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It prevents ion spots.	
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Learning elements	*Training hours*
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Learning elements	*Training hours*
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De-emphasis	
4 **Example of a sound-reproduction circuit**	

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Learning elements	*Training hours*
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SCR voltage-regulator circuit	

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